MEDFORD HIGH SCHOOL
COURSE SYLLABUS

Department:	Science
Course Title:	Physics
Level and/or Grade:	Standard; Grades 11-12
Prerequisite:	A passing grade in Biology and Chemistry.

Course Description:

This course is designed for students who started their science course sequence with Biology and Chemistry. It will give students a coherent modern view of Physics with a strong foundation in Newtonian mechanics and wave kinematics. Emphasis is placed on understanding the basic laws and concepts of Physics. The major topics of the course are motions and forces, energy, momentum, mechanics, electricity and magnetism, waves and optics. Experimentation, classroom demonstrations and problem-solving applications are used to accomplish the goals outlined above.

Learning Standards: *Students will be able to…..*

Motion and Forces:

- Distinguish between vector quantities and scalar quantities; understand how to add vectors using scale drawings and trigonometry; solve relative motion problems with vector addition.
- Distinguish between, and solve problems involving velocity, speed (constant and average), and constant acceleration.
- Solve problems, in one or two dimensions, involving displacement and distance.
- Distinguish the difference between mass and weight; calculate weight.
- Create, interpret, and solve problems involving graphs of motion; describe relationships among time, distance, and speed and among position, velocity, acceleration, and time.
- Understand, interpret, and apply Newton's three Laws of Motion: Inertia; Force and Acceleration; Action and Reaction; measure and calculate the magnitude of frictional forces and Newton's three Laws of Motion.
- Understand the existence of normal forces and calculate them.
- Qualitatively and quantitatively distinguish between static and kinetic friction, what they depend on and their effects on the motion of objects.
- Understand Newton's Law of Universal Gravitation; solve problems involving this law; measure and calculate the magnitude of gravitational forces.
- Qualitatively understand centripetal acceleration and centripetal forces.
- Solve 2-dimensional trajectory, 2-dimensional vector, and 2-dimensional static and non-static problems.
- Understand the effects of local gravity.

Conservation of Energy and Momentum:

- Define work, power, mechanical energy, potential energy, and kinetic energy; understand, interpret, and provide examples for the law of conservation of energy.
- Apply quantitatively the law of conservation of mechanical energy to simple systems; solve problems involving conservation of energy in simple systems with various sources of potential energy.

- Describe the relationship among energy, work, and power both conceptually and quantitatively; analyze the relationship between temperature, internal energy, and work done in a physical system; analyze and measure power.
- Define momentum; understand, interpret, and provide examples that illustrate the law of conservation of momentum.
- Define impulse; understand its relationship to momentum; solve impulse/momentum problems.
- Use formulas to calculate kinetic energy ($E = \frac{1}{2} mv^2$), changes in gravitational potential energy near Earth (change in potential energy = mgh), and momentum.
- Measure and calculate the vector nature of momentum; solve problems involving collisions in one dimension using the principles of conservation of momentum.

Waves and Optics:

- Describe the properties and characteristics of waves; describe wave motion.
- Distinguish between transverse waves and longitudinal waves; identify these waves in mechanical media and on earth.
- Describe factors that affect the speed of a wave; explain the relationship between the speed of a wave and the medium it travels through.
- Identify characteristic properties of waves and determine the behavior of waves: constructive and destructive interference (beats) for one and two dimensions, diffraction, refraction, reflection, Doppler effect, and superposition of harmonics.
- Solve problems involving wavelength, frequency, and wave speed.
- Understand, qualitatively and quantitatively, standing waves on a string and in a column of air.
- Understand that speed of light depends on the medium.
- Understand reflection and refraction of light.
- Understand and solve, graphically and through the thin lens equation, thin lens problems for real and virtual images; distinguish between real and virtual images.

Electromagnetism:

- Recognize the characteristics of static charge, and explain how a static charge is generated.
- Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them; predict the voltage and current in DC (series and parallel) electric circuits; use a formula to calculate power in any resistive circuit element; determine equivalent resistances in series and parallel circuits.
- Solve problems involving Ohm's Law.
- Interpret and apply Coulomb's Law conceptually and quantitatively.
- Understand that magnetic materials and electric currents are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources; determine the direction of a magnetic field.
- Understand conceptually what electric and magnetic fields are; understand that they contain energy and act as vector force fields.
- Understand that electric currents create magnetic fields and how to determine the magnitude and direction of fields created by a long straight wire, a coil of wire, and a solenoid.
- Understand that a moving charge or a current carrying a wire in a magnetic field will feel a force; understand how to determine the magnitude and direction of the force(s).
- Understand how a D.C. motor operates.
- Understand that the relative motion of a wire through a magnetic field can induce a voltage.
- Understand and apply Faraday and Lenz' Laws.
- Understand how electricity is generated.
- Know that the force on a charged particle in an electric field is qE; calculate the electric field resulting from a point charge; understand how to draw the electric field for a positive or negative charge.

- Understand and calculate electrical potential energy, electrical potential, potential difference, and voltage.
- Distinguish between mechanical and electromagnetic waves; explain the processes that result in the production and energy transfer of electromagnetic waves; understand that a changing magnetic field creates a changing electric field and can result in an electromagnetic wave.

Electromagnetic Radiation:

- Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.
- Describe the electromagnetic spectrum for wavelength and energy; be able to identify specific regions such as visible light; recognize ways in which direction of visible light can be changed.
- Explain how the various wavelengths in the electromagnetic spectrum have many useful applications such as radio, TV, microwaves, and cellular phones.

Standards for Literacy in History/Social Studies, Science, and Technical Subjects:

Key Ideas and Details

1. Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from text.
2. Determine central ideas or themes of a text and analyze their development; summarize the key supporting details and ideas.
3. Analyze how and why individuals, events, or ideas develop and interact over the course of a text.

Craft and Structure

4. Interpret words and phrases as they are used in a text, including determining technical, connotative, and figurative meanings, and analyze how specific word choices shape meaning or tone.
5. Analyze the structure of texts, including how specific sentences, paragraphs, and larger portions of the text (e.g., a section, chapter, scene, or stanza) relate to each other and the whole.
6. Assess how point of view or purpose shapes the content and style of a text.

Integration of Knowledge and Ideas

7. Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.
8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.
9. Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.

Range of Reading and Level of Text Complexity

10. Read and comprehend complex literary and informational texts independently and proficiently.

Standards for Writing in History/Social Studies, Science, and Technical Subject:

Text Types and Purposes

1. Write arguments to support claims in an analysis of substantive topics or texts using valid reasoning and relevant and sufficient evidence.
2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
3. Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details and well-structured event sequences.

Production and Distribution of Writing

4. Produce clear and coherent writing in which the development organization and style are appropriate to task, purpose, and audience.
5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, and trying a new approach.

6. Use technology, including the internet, to produce and publish writing and to interact and collaborate with others.

Research to Build and Present Knowledge

7. Conduct short as well as more sustained research projects based on focused questions, demonstrating understanding of the subject under investigation.
8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.
9. Draw evidence from literary and informational texts to support analysis, reflection, and research.

Range of Writing

10. Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of tasks, purposes, and audiences.

Course Alignment with 21st Century Learning Expectations:

Students will…

- Become self-directed learners.
- Communicate effectively.
- Apply problem-solving skills and critical and creative thinking.
- Use technology appropriately as a tool for learning, collaboration, presentation, research, and design.
- Act with integrity, respect and responsibility toward themselves, others and the environment.
- Exhibit flexibility and adaptability.
- Collaborate in diverse groups to share knowledge, build consensus, and achieve goals.
- Practice leadership in and service to their community.

Become contributing citizens in a global society.

Assessment:

- See grading policy attached.